Full wwPDB X-ray Structure Validation Report ⓘ

Apr 22, 2021 – 02:16 am BST

PDB ID	:	7APE
Title	:	Crystal structure of LpqY from Mycobacterium thermoresistible in complex with trehalose
Authors	:	Furze, C.M.; Guy, C.M.; Angula, J.; Cameron, A.D.; Fullam, E.
Deposited on	:	2020-10-16
Resolution	:	1.70 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see references ①) were used in the production of this report:

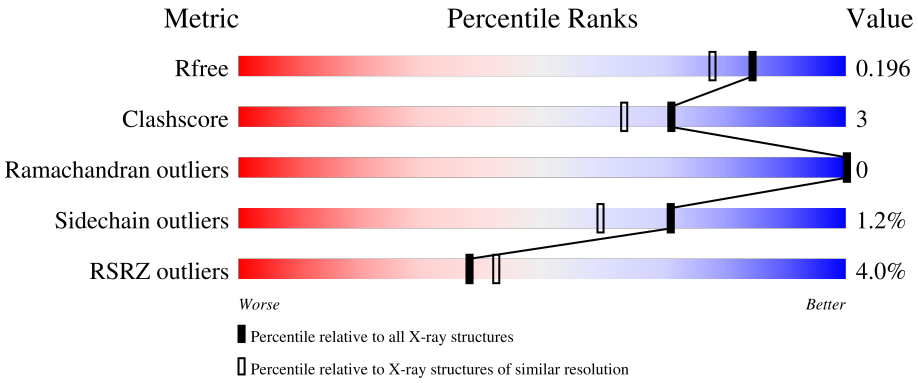
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.18
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.18

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	4298 (1.70-1.70)
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	451	2% 89% 7%
1	B	451	6% 88% 8%
2	C	2	100%
2	D	2	100%

2 Entry composition

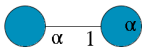
There are 3 unique types of molecules in this entry. The entry contains 13826 atoms, of which 6558 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Lipoprotein (Sugar-binding) lpqY.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	435	Total	C	H	N	O	S	0	0	0
			6584	2084	3254	583	656	7			
1	B	435	Total	C	H	N	O	S	0	1	0
			6595	2088	3260	583	657	7			

- Molecule 2 is an oligosaccharide called alpha-D-glucopyranose-(1-1)-alpha-D-glucopyranose.



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	2	Total	C	H	O	0	0	0
			45	12	22	11			
2	D	2	Total	C	H	O	0	0	0
			45	12	22	11			

- Molecule 3 is water.

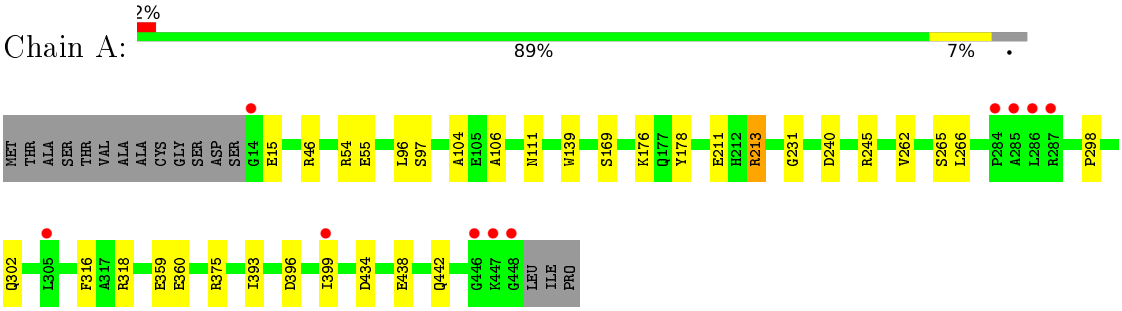
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	266	Total	O	0	0
			266	266		
3	B	291	Total	O	0	0
			291	291		

3 Residue-property plots (i)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density (RSRZ > 2). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

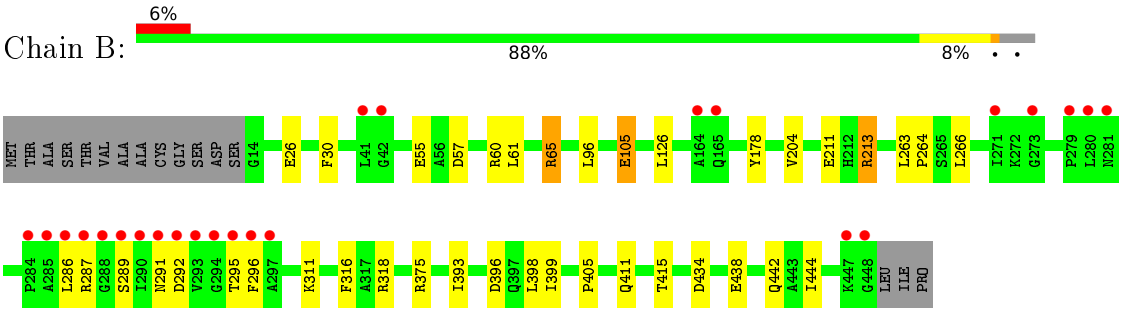
- Molecule 1: Lipoprotein (Sugar-binding) lpqY

Chain A:



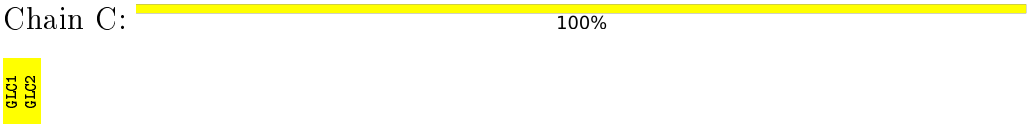
- Molecule 1: Lipoprotein (Sugar-binding) lpqY

Chain B:



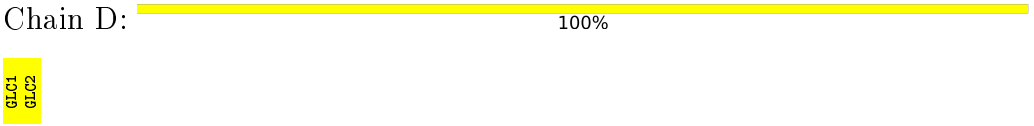
- Molecule 2: alpha-D-glucopyranose-(1-1)-alpha-D-glucopyranose

Chain C:



- Molecule 2: alpha-D-glucopyranose-(1-1)-alpha-D-glucopyranose

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α, β, γ	92.36Å 92.36Å 216.58Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.40 – 1.70 54.14 – 1.70	Depositor EDS
% Data completeness (in resolution range)	98.7 (48.40-1.70) 98.7 (54.14-1.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.27 (at 1.70Å)	Xtriage
Refinement program	PHENIX 1.15.2	Depositor
R, R_{free}	0.169 , 0.196 0.169 , 0.196	Depositor DCC
R_{free} test set	5141 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	26.1	Xtriage
Anisotropy	0.100	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.39 , 42.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	13826	wwPDB-VP
Average B, all atoms (Å^2)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.93% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GLC

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	#$\|Z\|>5$	RMSZ	#$\|Z\|>5$
1	A	0.50	0/3398	0.65	1/4641 (0.0%)
1	B	0.51	0/3406	0.67	2/4651 (0.0%)
All	All	0.50	0/6804	0.66	3/9292 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	213	ARG	NE-CZ-NH2	-6.30	117.15	120.30
1	B	65	ARG	NE-CZ-NH1	-5.74	117.43	120.30
1	B	213	ARG	NE-CZ-NH2	-5.44	117.58	120.30

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3330	3254	3254	22	0
1	B	3335	3260	3260	29	0
2	C	23	22	21	0	0
2	D	23	22	21	0	0
3	A	266	0	0	5	1
3	B	291	0	0	3	1

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	7268	6558	6556	46	2

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 3.

All (46) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:399:ILE:HD11	1:B:398:LEU:HB3	1.42	1.02
1:A:97:SER:OG	3:A:601:HOH:O	1.78	0.99
1:A:438:GLU:OE2	1:A:442:GLN:NE2	2.02	0.92
1:A:399:ILE:HD11	1:B:398:LEU:CB	2.01	0.91
1:B:105:GLU:OE2	3:B:601:HOH:O	2.00	0.79
1:A:55:GLU:OE1	1:A:176:LYS:NZ	2.23	0.72
1:A:213:ARG:NH2	1:A:434:ASP:OD1	2.24	0.68
1:B:287:ARG:HA	1:B:287:ARG:NE	2.09	0.67
1:B:411:GLN:O	1:B:415:THR:HG23	1.96	0.66
1:B:213:ARG:NH2	1:B:434:ASP:OD1	2.31	0.62
1:B:396:ASP:O	1:B:399:ILE:HG12	2.00	0.62
3:A:759:HOH:O	1:B:399:ILE:HD11	2.00	0.61
1:B:316:PHE:HD1	1:B:393:ILE:HD12	1.69	0.58
1:B:316:PHE:CD1	1:B:393:ILE:HD12	2.39	0.58
1:B:438:GLU:OE2	1:B:442:GLN:NE2	2.29	0.54
1:B:61:LEU:HD21	1:B:65:ARG:HH12	1.72	0.54
1:B:96:LEU:HD22	1:B:126:LEU:HB3	1.90	0.52
1:B:204:VAL:HG23	1:B:444:ILE:HD11	1.93	0.51
1:B:292:ASP:N	1:B:292:ASP:OD1	2.43	0.51
1:A:15:GLU:CD	1:A:46:ARG:HG3	2.31	0.50
3:A:632:HOH:O	1:B:318:ARG:HD2	2.12	0.50
1:B:55:GLU:HB3	1:B:57:ASP:OD1	2.11	0.50
1:A:106:ALA:HB2	1:B:211:GLU:HG3	1.95	0.49
1:B:286:LEU:O	1:B:289:SER:HB2	2.11	0.49
1:B:263:LEU:HB3	1:B:264:PRO:HD3	1.94	0.48
1:B:311:LYS:HD2	3:B:685:HOH:O	2.13	0.48
1:B:26:GLU:HG3	1:B:30:PHE:CE2	2.49	0.48
1:B:289:SER:HG	1:B:296:PHE:HE1	1.62	0.47
1:A:211:GLU:HG2	3:A:695:HOH:O	2.15	0.47
1:A:106:ALA:HB2	1:B:211:GLU:CG	2.46	0.46
1:B:60:ARG:NE	1:B:411:GLN:HG3	2.31	0.46
1:A:245:ARG:HD2	1:A:265:SER:OG	2.16	0.46
1:A:399:ILE:HD11	1:B:398:LEU:HB2	1.91	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:298:PRO:HB2	1:A:302:GLN:HB2	1.98	0.45
1:A:396:ASP:O	1:A:399:ILE:HG22	2.17	0.44
1:B:405:PRO:HG3	3:B:803:HOH:O	2.18	0.43
1:A:316:PHE:HD1	1:A:393:ILE:HD12	1.83	0.43
1:A:111:ASN:O	1:A:375:ARG:HA	2.19	0.43
1:A:139:TRP:CE3	1:A:316:PHE:HB3	2.54	0.43
1:A:169:SER:HB2	1:A:231:GLY:HA3	2.01	0.42
1:A:359:GLU:OE1	1:A:360:GLU:OE2	2.37	0.42
1:A:262:VAL:HG13	3:A:661:HOH:O	2.19	0.42
1:B:287:ARG:HA	1:B:287:ARG:CZ	2.49	0.41
1:A:176:LYS:HE2	1:A:240:ASP:HB3	2.02	0.41
1:A:96:LEU:HG	1:A:104:ALA:HB1	2.03	0.41
1:B:291:ASN:OD1	1:B:295:THR:N	2.54	0.41

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:810:HOH:O	3:A:810:HOH:O[7_466]	2.08	0.12
3:B:839:HOH:O	3:B:871:HOH:O[6_465]	2.16	0.04

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	433/451 (96%)	421 (97%)	12 (3%)	0	100	100
1	B	434/451 (96%)	422 (97%)	12 (3%)	0	100	100
All	All	867/902 (96%)	843 (97%)	24 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains (i)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	343/355 (97%)	339 (99%)	4 (1%)	71	59
1	B	344/355 (97%)	340 (99%)	4 (1%)	71	59
All	All	687/710 (97%)	679 (99%)	8 (1%)	71	59

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	54	ARG
1	A	178	TYR
1	A	266	LEU
1	A	318	ARG
1	B	105	GLU
1	B	178	TYR
1	B	266	LEU
1	B	375	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	123	ASN
1	A	426	GLN
1	B	123	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates (i)

4 monosaccharides are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	GLC	C	1	2	11,11,12	1.56	1 (9%)	15,15,17	1.22	4 (26%)
2	GLC	C	2	2	12,12,12	1.05	1 (8%)	17,17,17	0.64	0
2	GLC	D	1	2	11,11,12	1.62	3 (27%)	15,15,17	0.91	0
2	GLC	D	2	2	12,12,12	1.22	2 (16%)	17,17,17	0.69	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	GLC	C	1	2	-	2/2/19/22	0/1/1/1
2	GLC	C	2	2	-	0/2/22/22	0/1/1/1
2	GLC	D	1	2	-	2/2/19/22	0/1/1/1
2	GLC	D	2	2	-	0/2/22/22	0/1/1/1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	1	GLC	O5-C1	3.66	1.49	1.43
2	D	1	GLC	O5-C1	3.36	1.49	1.43
2	D	2	GLC	O5-C1	3.17	1.50	1.42
2	D	1	GLC	O5-C5	2.94	1.49	1.43
2	D	2	GLC	O5-C5	2.47	1.50	1.44
2	D	1	GLC	C2-C3	-2.31	1.49	1.52
2	C	2	GLC	O5-C1	2.27	1.48	1.42

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	C	1	GLC	O5-C1-C2	-2.31	107.20	110.77
2	C	1	GLC	O2-C2-C3	2.14	114.42	110.14
2	C	1	GLC	O3-C3-C2	-2.09	106.00	109.99
2	C	1	GLC	O2-C2-C1	-2.02	105.02	109.15

There are no chirality outliers.

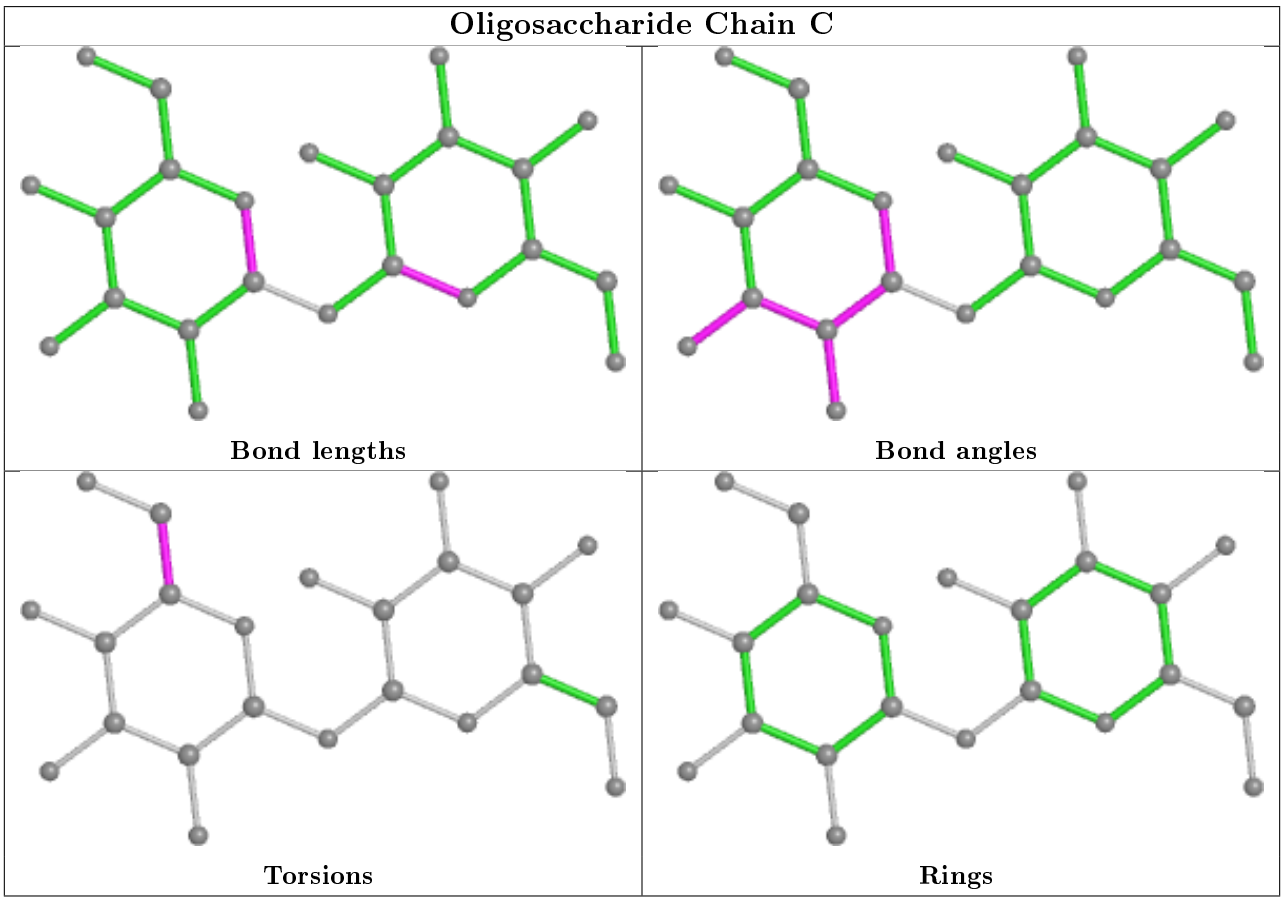
All (4) torsion outliers are listed below:

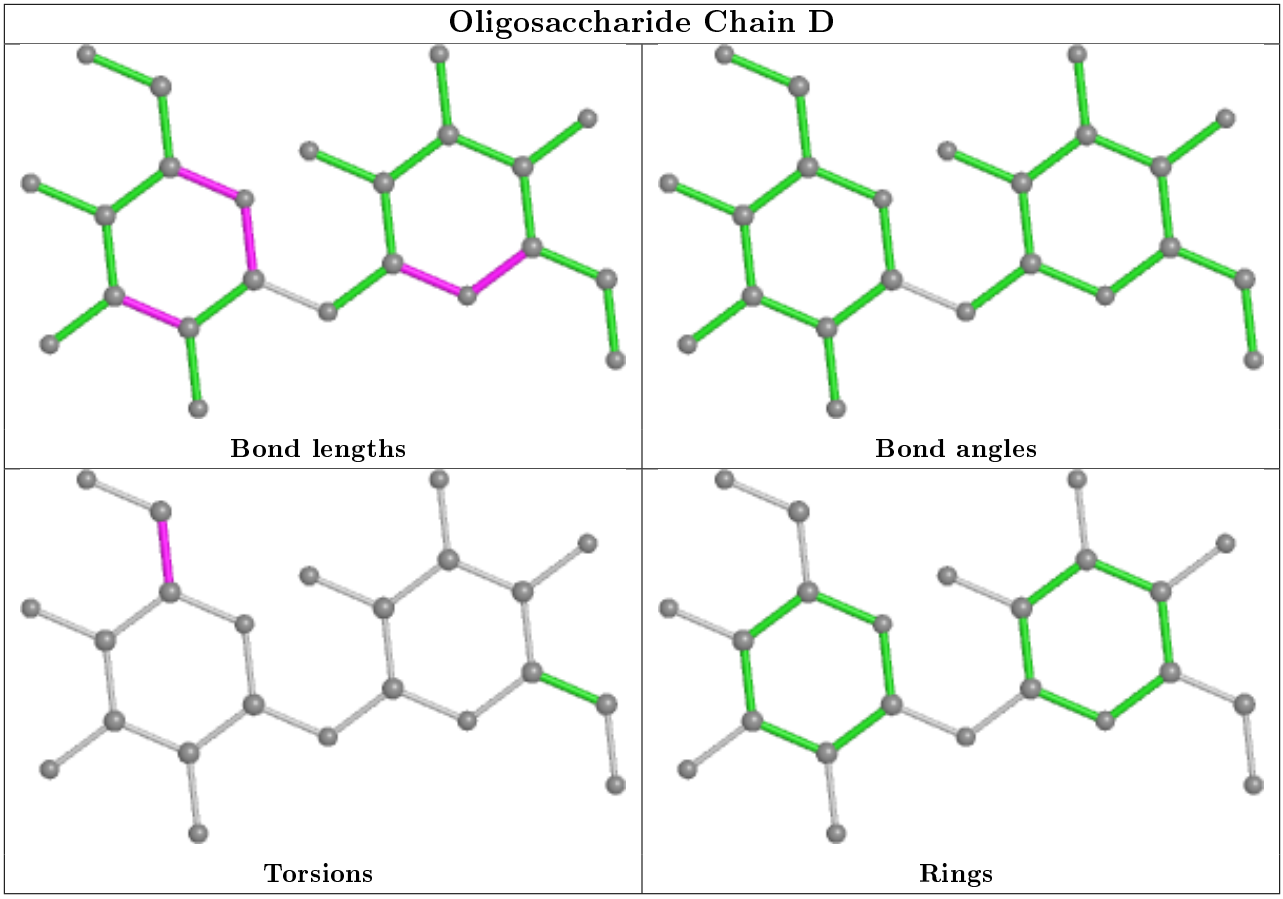
Mol	Chain	Res	Type	Atoms
2	C	1	GLC	O5-C5-C6-O6
2	D	1	GLC	O5-C5-C6-O6
2	D	1	GLC	C4-C5-C6-O6
2	C	1	GLC	C4-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for oligosaccharide.





5.6 Ligand geometry (i)

There are no ligands in this entry.

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled '#RSRZ> 2' contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95^{th} percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled 'Q< 0.9' lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å^2)	Q<0.9
1	A	435/451 (96%)	-0.00	10 (2%)	60	65	16, 27, 46, 75	0
1	B	435/451 (96%)	0.16	25 (5%)	23	26	17, 26, 52, 98	0
All	All	870/902 (96%)	0.08	35 (4%)	38	42	16, 27, 49, 98	0

All (35) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	293	VAL	9.5
1	B	292	ASP	7.1
1	A	447	LYS	6.9
1	B	290	ILE	6.5
1	B	284	PRO	6.0
1	B	287	ARG	5.7
1	A	448	GLY	5.5
1	B	286	LEU	5.4
1	B	295	THR	5.2
1	B	297	ALA	5.2
1	B	294	GLY	4.9
1	B	285	ALA	4.7
1	B	296	PHE	4.2
1	A	14	GLY	4.0
1	A	287	ARG	3.7
1	B	271	ILE	3.5
1	B	165	GLN	3.5
1	A	284	PRO	3.3
1	B	448	GLY	3.1
1	B	273	GLY	2.9
1	B	42	GLY	2.8
1	B	280	LEU	2.8
1	B	447	LYS	2.8
1	A	446	GLY	2.7

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Mol	Chain	Res	Type	RSRZ
1	B	288	GLY	2.6
1	A	305	LEU	2.4
1	B	281	ASN	2.3
1	B	291	ASN	2.3
1	A	286	LEU	2.3
1	A	285	ALA	2.3
1	B	289	SER	2.2
1	B	164	ALA	2.2
1	B	279	PRO	2.2
1	B	41	LEU	2.1
1	A	399	ILE	2.0

6.2 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates (i)

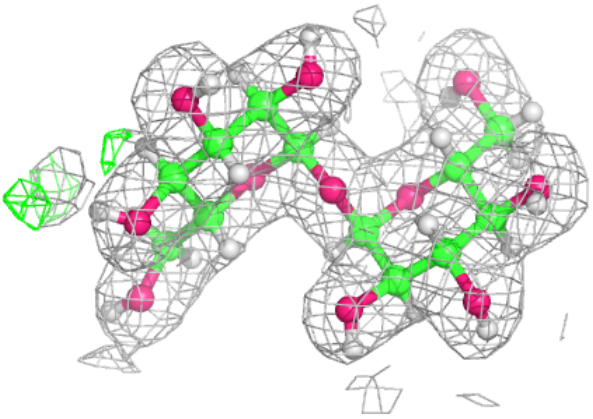
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

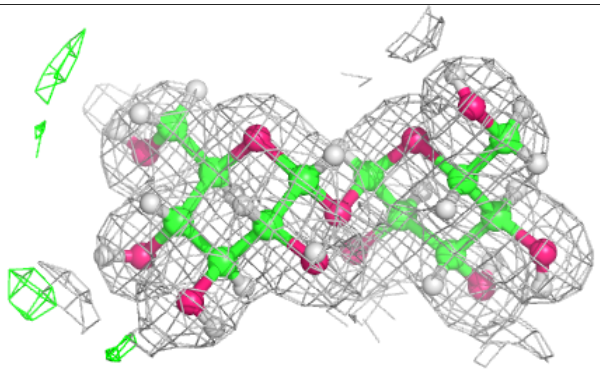
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	GLC	C	1	11/12	0.98	0.08	17,22,27,29	0
2	GLC	C	2	12/12	0.98	0.08	18,20,25,26	0
2	GLC	D	1	11/12	0.98	0.08	17,23,26,28	0
2	GLC	D	2	12/12	0.98	0.10	18,21,24,27	0

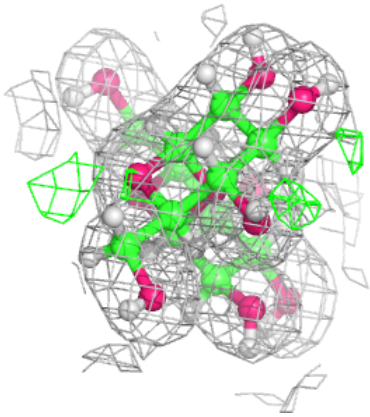
The following is a graphical depiction of the model fit to experimental electron density for oligosaccharide. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around Chain C:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

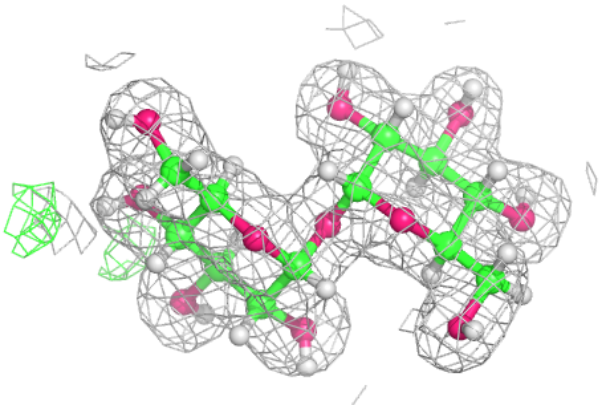


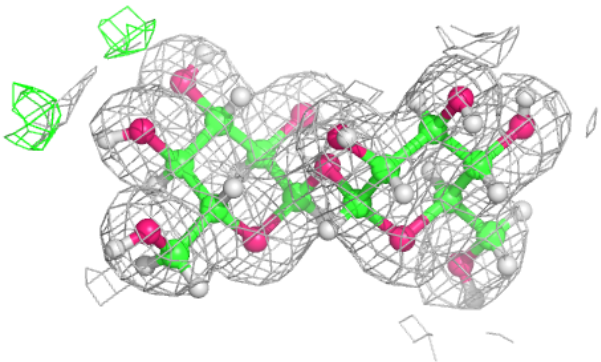


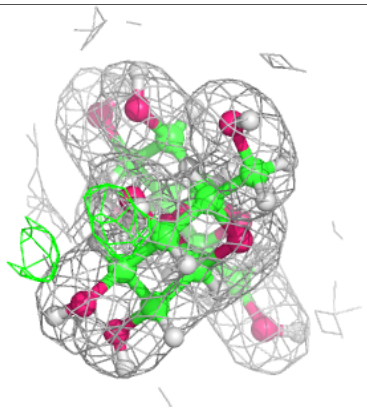


Electron density around Chain D:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)







6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.